C-A TPL 05-06 TEMPORARY PROCEDURE TO LIMIT THE NUMBER OF P^ IN THE AtR TRANSFER LINE

Text Pages 2 through 8

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C-A TPL 05-06 TEMPORARY PROCEDURE TO LIMIT THE NUMBER OF P^ IN THE AtR TRANSFER LINE

1. Purpose

1.1 The purpose of this procedure is to instruct MCR Operators and Operations Coordinators (OCs) in the use of the tools provided for the purpose of limiting the number of protons in the AtR line.

1.2 This procedure, and the AGS B15 Current Transformer interlock feature, affects machine operation whenever protons are fast extracted from the AGS into the W line (i.e. the psuarc8 (8 degree) and pswarc20 (20 degree) power supplies are **on**). These transformers have been incorporated into the "Cross Interlock", the system that prevents high intensity beam into the downstream U line and RHIC. This procedure does **not** affect machine operation when high intensity protons are fast extracted into the V line or slow extracted (the psuarc8 (8 degree) and pswarc20 (20 degree) power supplies are **off**) or when the beam stops in LtB are closed.

1.3 A pair of commercial current transformers have been installed in the AGS in the B15 straight section. The transformers guard against a mistake that would send a beam of high intensity protons, that were intended for BLIP, to RHIC. When in a "fault" state, the current transformers act to turn off the beam via the AGS Beam Inhibit system, and via the Access Controls system.

2. Responsibilities

2.1 MCR operations group members are responsible for the execution of this procedure.

2.2 The Chairman of the Radiation Safety Committee shall authorize any changes to the frequency of verification of current transformer operation

3. Prerequisites

3.1 The AGS B15 circulating beam current transformer including the current transformer inputs into the Access Controls System and the Beam Permit System is operational.

3.2 The target group for this procedure is the MCR Operators and OCs.

3.3 The training requirement for this procedure is read and sign.

3.4 The minimum number of staff members that need to be trained in order for this procedure to be effective is two, one OC and one operator.

4. Precautions

4.1 The possibility of a real high intensity interlock is increased just after a period when the high intensity source is used to send protons to the Injectors/RHIC (while the polarized proton source undergoes maintenance). The on duty Operations Coordinator shall verify the "injector configuration" in this situation, to assure that protons from the high intensity source will not be permitted into the injectors, before beam is extracted into the transfer line (AtR).

4.2 The B15 Current transformer system is an expert device. IF there are any problems, THEN contact the cognizant engineer (M. Wilinski). Do not contact CAS to service the transformers or transformer electronics.

5. Procedure

Note 1 :
The gain settings of the B15 transformer are set for 2 amps in "pet". Any other value will cause the system to interlock the beam.

5.1 Some useful Access Controls Logic relevant to this procedure.

5.1.1 To open the "vacuum valve" that is the beam stop downstream of the high intensity proton source one the following must be true:

5.1.1.1 The 8 and 20 degree bend power supplies (psuarc8 and pswarc20) must be off, or
5.1.1.2 LtB Beam stops 1 and 2 are closed (or LtB BS1 and LTB.DH1 ps off), or
5.1.1.3 B15 Current Transformers A and B are OK (not tripped, & Keep alive on).

5.1.2 To Open the LtB beam stops one the following must be true:

5.1.2.1 The 8 and 20 degree bend power supplies (psuarc8 and pswarc20) must be off, or
5.1.2.2 B15 Current Transformer A is OK (not tripped, & Keep alive on) and the valve that is downstream of the high intensity source is closed, or
5.1.2.3 B15 Current Transformers A and B are OK (not tripped, & Keep alive on).

5.1.3 To turn on the 8 and 20 degree bend power supplies (psuarc8 and pswarc20) one the following must be true:

5.1.3.1 LtB Beam Stops 1 & 2 (or LtB BS1 and LTB.DH1 ps off) are closed, or
5.1.3.2 B15 Current Transformer A is OK (not tripped, & Keep alive on) and the valve that is downstream of the high intensity source is closed, or
5.1.3.3 B15 Current Transformers A and B are OK (not tripped, & Keep alive on).

5.2 Automation

5.2.1 Many of the VERIFICATION steps (paragraph 5.4) of this procedure lend themselves to automation using a "TAPE/sequencer" as is standard practice in RHIC and SEB operations. Before Operations may use an automated version of the steps in paragraph 5.4.1.3 and 5.4.1.4, approval of the contents of the sequence shall be given by the cognizant "B15 Current Transformer Interlock Physicist", Leif Ahrens.

5.3 Operation

Note 2:
The B15 current transformers have the potential to inhibit the beam via the Access Control System AND the Beam Permit System (BPS). **The inputs to the Access Controls System are ignored if the psuarc8 and pswarc20 power supplies are off OR if LtB beam stops 1 and 2 are closed OR if LtB beam stop 2 and LtB magnet DH1 power supply is off**. The inputs to the Beam Permit System are ignored when the inputs are masked off. High Intensity Proton Operation requires that the supplies be off and the BPS inputs masked.

5.3.1 The cognizant engineer has set the window of operation for B15 interlock electronics at ~~35mA~~ 140mA (~~6x10^{11}~~ 2.4x10^{12} protons) total beam current in the AGS. Changes to the interlock level must be authorized by the cognizant B15 Current Transformer Interlock Physicist and the Chairman of the Radiation Safety Committee, or his designee.

5.3.2 IF psuarc8 and pswarc20 are on, AND the LtB beam stops are opened THEN the B15 inputs to the Beam Permit System shall **not** be masked off. IF psuarc8.ps and pswarc20.ps are on and LtB beam stops are closed then the Beam Permit System inputs may be TEMPORARILY masked off

5.3.3 IF a ~~***inBitsText.b18-vme.A0 "B15 CT difference too large***~~**B15_IN_DIFF_FAIL:**" alarm is seen on the ADT (except when executing step 5.4.1.4.2.9) then report the occurrence via e-mail to the cognizant engineer and technicians, and the ASSRC chair (Wilinski@bnl.gov, Ziminski@bnl.gov, Curcio@bnl.gov, jglenn@bnl.gov).

5.3.3.1 IF a difference alarm annunciates then execute paragraph 5.4 of this procedure .

5.4 Verification of "Keep Alive & Over-Limit" Operation

5.4.1 During proton operations, IF psuarc8 and pswarc20 are on for beam operations at any time during the day, THEN do the following once every day – without hindering RHIC operation.

Note 3:
The Chairman of the Radiation Safety Committee may verbally authorize any changes to the frequency of verification. Such changes shall be logged in the OC log.

5.4.1.1 Verify that the FOUR AGS B15 Interlock inputs (B15 CT A/B OVER LIMIT, B15 CT A/B KEEP ALIVE) into the Beam Permit System are not masked off and are enabled.

5.4.1.2 Inhibit Linac pulse & turn off AGS extraction (DC) bumps

5.4.1.3 Keep Alive Verification (**pet/AGS/Instrumentation/B15_Current-Xfmr**)

Note 4:
The "Keep Alive" readback for both transformers should be approximately 65mV

5.4.1.3.1 For Xfmr A

5.4.1.3.1.1 Open/Turn on AGS critical devices (eg. beam stops)

5.4.1.3.1.2 Change 'Gain Cntl' to **20amp**

5.4.1.3.1.3 Observe B15 CT A KEEP ALIVE alarm on the ADT and a fail indication at pet/AGS/Safety/Beam_Inhibit/Permit. Also observe beam stops close.

5.4.1.3.1.4 Return Gain Cntl to **2amp** and activate

5.4.1.3.1.5 Activate "Reset Cntl" (left then middle click)

5.4.1.3.1.6 Reset Beam_Inhibit/Permit (executeNow) at pet/AGS/Safety/Beam_Inhibit/Permit

5.4.1.3.1.7 Repeat the previous six steps for Xfmr B

5.4.1.4 Over-Limit Verification (**pet/AGS/Instrumentation/B15_Current-Xfmr**)

Note 5:
The "Hi I Level" readback for both transformers should be approximately ~~0.18~~0.74V

5.4.1.4.1 Set (if not already set) B18_GPIB_Keithley "Level" to ~~0.04~~**0.15**.
Set (if not already set) B18_GPIB_Keithley "Range" to **1Amp**
Set (if not already set) B18_GPIB_Keithley "Mode" to **DC**
Beware of 8 second delay to make the changes above.

5.4.1.4.2 For Xfmr A

5.4.1.4.2.1 Open/Turn on AGS critical devices (eg. beam stops)
5.4.1.4.2.2 Change "Cal Cntl" to **Cal**
5.4.1.4.2.3 Change B18_GPIB_Keithley Enable parameter to **On.** The readback below will read OK Now On
5.4.1.4.2.4 Observe B15 CT A OVER LIMIT alarm on the ADT and a fail indication at pet/AGS/Safety/Beam_Inhibit/Permit. Also observe beam stops close.
5.4.1.4.2.5 Change B18_GPIB_Keithley Enable parameter to **Off.** The readback below will read OK Now Off
5.4.1.4.2.6 Change "Cal Cntl" to **Off**
5.4.1.4.2.7 Activate "Reset Cntl" (left then middle click)
5.4.1.4.2.8 Reset Beam_Inhibit/Permit (executeNow) at pet/AGS/Safety/Beam_Inhibit/Permit
5.4.1.4.2.9 Ignore any Transformer Difference Failure Alarms
5.4.1.4.2.10 Repeat the nine above steps for Xfmr B.

5.4.2 Configure the Transformers and Beam_Inhibit for normal operation as well as Linac trigger and AGS extraction bumps.

5.4.3 The OC shall make note of successful and unsuccessful tests each day in the OC shift log.

5.5 Recovery from an high beam intensity interlock

5.5.1 IF the critical devices are turned off due to an B15 Current Transformer interlock, THEN

5.5.1.1 Keep the 8 and 20 degree bend power supplies off and defeat AGS extraction.
5.5.1.2 Determine the reason for the high intensity beam pulse.
5.5.1.3 Report the event to the cognizant B15 Current Transformer Interlock Physicist.
5.5.1.4 Report the event in the Operations Coordinator Shift Log
5.5.1.5 Get permission to restart from the cognizant B15 Current Transformer Interlock Physicist or designee.
5.5.1.6 Reduce the intensity of the proton beam that will be injected into the Booster.
5.5.1.7 Go to pet/AGS/Safety/Beam_Inhibit/Permit and enable (trigger) the input channels (CT A, and CT B) that were disabled by the interlock
5.5.1.8 Go to pet/AGS/Instrumentation/B15_Current_Xfmr page and reset both Xfmr A and Xfmr B using Reset Cntl at the top of the page (left and middle click each one to reset.
5.5.1.9 Turn on the AGS and RHIC critical devices
5.5.1.10 Resume operation.

6. Documentation

    6.1 OC Shift Log

7. References:

    7.1 B15 Transformers Interlock Test Procedure, 3-1-05, M. Wilinski

8. Attachments:

    8.1 B15 Transformers Interlock Test Procedure, 3-1-05, M. Wilinski

B15 Transformers Interlock Startup/Test Procedure 3-1-05
M. Wilinski

1. The PET page for controls is located at -> AGS/Instrumentation/B15_Current_Xfmr
NOTE: The transformers are located in the B15 section of the AGS ring; the electronics are in the B18 House. The transformers are designated in hardware and software as "Xfmr A" and "Xfmr B". These transformers are set to interlock at AGS currents above ~~35mA~~140mA.

A. Calibration/Startup Test

2. Once a year, ideally during the annual shutdown, open up transformer enclosure in AGS Ring and visually inspect the integrity of the ceramic gap and the capacitor ring. Electrically test the ceramic gap to make sure it has not shorted.

3. Once a year, ideally just before startup, power down the Bergoz electronics, wait approximately 15 minutes, and then reapply power to the electronics. This will start an internal demagnetizing process that will re-acclimate the transformers to the current ring conditions. This procedure is only done on power-up of the electronics.

4. Check on a scope that the keep alive current from each transformer is centered and symmetric around the 0V baseline. Use the fine adjustment on the Bergoz electronics if necessary.

5. Use the Keithley current source at B18 House to inject a fixed amount of current into the calibration winding of each transformer. Check on a scope that the voltage readout from the Bergoz electronics is reading the correct amount of volts/amps based on the gain setting on the pet page. Use adjustment on Bergoz electronics if necessary.
NOTE: Full scale voltage output of the Bergoz electronics is 10V. For example, if the gain range is set to 2A, the volts/amps scaling is 1V/0.2A.

6. Check the interlock threshold setpoints in the electronics for the keep-alive and high-current limit for both transformers. Verify that the high-current thresholds meet the RSC approved value. Verify that the keep-alive threshold is appropriate for the gain range that will be used during operations.

B. Keep-Alive Test
NOTE: The Keep Alive MADC readback on the Pet page should be approximately 65mV.

7. Change Xfmr A 'Gain Cntl' parameter (Gain Control) to 20A.
NOTE: The 200mA or 20mA ranges would also work for this test; however these ranges may also generate over-limit faults. It is most prudent to only generate one failure at a time.

8. Should receive a Keep Alive Failure in the Beam Permit and Access Controls systems for Xfmr A. Change the Xfmr A gain control back to 2A. Press and activate (left mouse click followed by middle mouse click) the Xfmr A 'Reset Cntl' parameter (reset control) to clear the security system interlock. Clear the permit failure in the usual manner.
NOTE: The Access Controls system distinguishes faults by transformers, not by types of failures. The Permit system will indicate the type of failure and also the transformer that has produced the failure.
NOTE: The 2A Range is the standard operating mode and all trip levels in the electronics are based on this range. You will continue to get failures for the duration in which the gain range is not set to 2A and the interlocks are active. You will also not be able to reset any failures as long as the range is something other than 2A.

9. Repeat steps 7 and 8 for Xfmr B.

C. Over-limit Test

NOTE: The "Hi I Level" (high current level) MADC readback on the pet page should read approximately ~~0.18~~0.74V for both transformers. This is the equivalent voltage trip level for ~~35mA~~140mA.

10. Check that the B18_GPIB_Keithley Level parameter is set to ~~0.04~~0.15 ~~(i.e. 40mA),~~ the Range parameter is set to 1A, and the Mode is set to DC. If any of these parameters are not set as indicated, change them to the proper setting.

NOTE: When changing some values, there is about an 8 second delay from the time when you enter the proper value to when the unit accepts the value. The parameter will be highlighted for the duration of the delay and when the unit has accepted the value, the parameter will return to its normal coloring. DO NOT keep typing in the value and hitting enter as you will prolong the amount of time before the Keithley is available and yielding the desired value. Please show restraint and patience when changing values.

11. Change the 'Cal. Cntl' parameter (Calibration Control) for Xfmr A to 'Cal'.

12. Change the B18_GPIB_Keithley Enable parameter to 'On'. The readback message for the Keithley on this PET page should state "OK; Now On".

NOTE: The Keithley will not turn on and you will receive a readback error message on this page if the Xfmr A (or Xfmr B upon repeating this test) calibration control parameter is not set to 'Cal'.

13. Should receive an Over Limit Current Fault in the Beam Permit and Access Controls systems for Xfmr A. To clear the fault, change the Keithley Enable to 'Off', change the Xfmr calibration control to 'Off', and press and activate the Xfmr A 'Reset Cntl' parameter. Also clear the permit failure.

One should also receive a warning message indicating that there is a transformer Difference Failure. This indicates that two transformers are not reading the same value within some preset tolerance. This "failure mode" clears when the Keithley enable is turned off as the additional injected current is no longer present. This warning is used for diagnostic purposes only and it will not interlock anything. Therefore, the "Reset Fail" button is superfluous at this time, but exists for the potential of using it as an interlock in the future.

14. Repeat steps 11-13 for Xfmr B.